A REMOTE ELECTRICITY BILLING SYSTEM

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Bachelor of Technology in
ELECTRICAL ENGINEERING

By

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and
Chaitanya Prasad Murmu(108EE048)

Department of Electrical Engineering
National Institute Of Technology
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Under the Guidance of
Prof. Susmita Das

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CERTIFICATE

This is to certify that the thesis entitled "A Remote Electricity Billing System" submitted by Deepakraj Sahu (108EE020), Chaitanya Prasad Murmu (108EE048) in the partial fulfillment of the requirement for the degree of Bachelor of Technology in Electrical Engineering, National Institute of Technology, Rourkela, is an authentic work carried out by them under my supervision.

To the best of my knowledge the matter embodied in the thesis has not been submitted to any other university /institute for the award of any degree or diploma.

Date:

Prof .Susmita Das
Dept of Electrical Engineering
National Institute of Technology
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ACKNOWLEDGEMENT

We would like to express our deepest sense of gratitude towards our supervisor, Prof. Susmita Das who has given us much suggestion, guidance and support.

We are also grateful to Mr. Ayaskanta Swain of Electronics and Communication Engineering. Department for assisting us and guiding us throughout the project and furthered the project till this extent. We also take this opportunity to give thanks to all others who have given us support for the project.

Last, but not least, we would like to thank the authors of various research articles and book that we referred to during the course of the project.

Deepakraj Sahu

Chaitanya Prasad Murmu

ABSTRACT

Electric power distribution is the most valuable part of electrical power system in the process of delivering electricity to consumer. Electric power companies are now-a-days adopting some advanced systems such as computer aided monitoring control and management of electric power, so that it can provide better services to electric consumers. This project results an approach to automate the electricity billing system. The concept of prepaid is one of the emerging fields for the paid service providers. The concept is becoming so popular because it has so many advantages. The services like electricity, gas, water telephone etc are now days get privatized. The service provider company some time incurs heavy losses due to non collection of bills. These service items cannot be recovered from the user after providing, so the concept of prepaid reduce risk and increase profitability. Also the bill collection infrastructure is not necessary which intern increase improve the efficiency of the service providing companies. The concept of prepaid starts in the manual form by receiving advance deposits but now due to the revolution of IT and electronics industry the manual recharging process is replaced with automatic and electronic recharging. The recharging methods can be with wire based like telephone line and also by using wireless technology like radio and bluetooth communication. The prepaid system is designed with a smart technology using microcontroller and the recharging process is by some method of communication. The Mobile based recharging is very attractive recharging system. The recharging can be done from any remote place without accessing the energy meter physically. This concept of remote charging makes the system more flexible.

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CHAPTER-1

INTRODUCTION

1. **INTRODUCTION**

1.1 Introduction

The trend of the time has always been in favour of that technology which finally become cost-effective as well as an elegant one. Traditional meter reading is done by the human operator, this require a more number of labour operator and long working hour to achieve the complete area data reading and billing. Due to the increase in the development of residential building and commercial building the meter reading task increases which require more number of human operator. In order to achieve efficient meter reading, reduce billing error and operation cost, automatic meter reading system play an important role. Electric energy meters is the direct billing interface between utility grid and consumers and it undergone several advancements in the last decade.

In postpaid system, there is no control use of electricity from the consumer's side. There is a lot of wastage of power in the consumer's side due to lack of planning of electrical consumption in an efficient way.

A Prepaid Energy Meter is used to collect the electricity bills from the consumers according to their consumption. The prepaid meter is not only limited to automate the meter reading(AMR) but also attributed with prepaid recharging ability and information of consumed data can be exchange between the grid and consumer .The detail of consumed data which is send by the prepaid energy meter can be stored in the grid computer for future verification.

To automate the system of billing of energy is the main theme of this project. The front end of this project is user friendly and the employees can work on with minimum knowledge of computers.

CHAPTER-2

DESIGN PRINCIPLE

2. DESIGN PRINCIPLE

The Prepaid Energy meter with Mobile Based Recharging System is designed by using a 8 bit microcontroller. The Microcontroller receives the pulse by interfacing optical pickups from a traditional electromagnetic energy meter. The Prepaid Energy meter with Mobile Based Recharging System works with the principle as follows

2.1 Pulse Counting

The electronic energy meter is interfaced to the microcontroller through opto-isolator. The energy meter receives its Input from two number of CT's, one is connected to the phase and the other one is connected to the neutral. A V.T. through bridge rectifier is used to provide (+5V/+12V) to the microcontroller & other component for their use. So the processor reads V from V.T., I(depends on Power Factor) from C.T. and their product is seen on the digital screen of the Meter. The energy meter internal circuit working with a low voltage (+5v) which is not isolated. There are four LED on Energy Meter.

1. Phase (Mains ON)
2. Earth
3. Rev (Revolution)
4. Cal (Pulse counter)

The Microcontroller receives the pulse by interfacing optical pickups from a traditional electromagnetic energy meter. Since the energy meter is working with a non-isolated supply, we are using an isolation circuit to get a pulse from the energy meter called Opto-isolator circuit using a mct2e IC.

2.2 Overload Detection

This over current relay will work for A.C. Voltage and current. The sampling method in this design is based on the transformer principal. The load current passes through the primary of the transformer; the drop across the transformer is very negligible as the resistance of primary circuit is very less. But the flux developed due to primary current will induce an alternating voltage in

secondary winding. That voltage is very small and also very much weak by strength. The signal developed at the secondary is very much linear with input current until the core saturation takes place. The transformer o/p is a proportional signal with respect to line current. As this signal is very weak we use a buffer amplifier which is a unity gain amplifier, which doesn't change the value of the signal, but it increases the current or driving strength. Now this signal is sufficiently strong to be feed in to an amplifier which is an inverting amplifier which provide a fixed gain to the signal, the output of the amplifier is an alternating signal, which is filter rectified with a half weave rectifier and smoothen with a filter circuit. The rectifier output signal has to be companied with the set values. The existing comparator circuit has four comparator. So four reference values can be set with the help of presets. The comparator is always in line with the signal and indicates the level of current in the load line. With the help of a miniature rotary switch one of the comparator output will be chosen. The setting of that comparator reference voltage will be the indicative of tripping current.

2.3 Mobile Phone based recharging

In this project the Prepaid Energy meter can be charged from a remote by using a mobile. Once the user feel to recharge the prepaid energy meter, he can transfer the amount to the service provider bank account and the service provider will make a call to the system and log in to that and charge it by entering digits from its key pad. The recharging can be done from any mobile set but the system access code must be put in to the system to log into the energy meter. This type of systems are now days getting popular. Many popular and well known companies make products and sale in the market.

The energy meter sends a pulse to the microcontroller indicating a unit is consumed. The controller calculate the number of pulse and display the balance units left in the system. When the system do not have any balance it trips the main relay to disconnect the supply from load. When the user transfer money to the service provider's account then the service provider rings up to the mobile connected to the system and sends a code through the DTMF coding system, the controller programmed in the system reads that and recharge the system to start again. The system is installed with an embedded operating system to provide a user friendly environment with the help of alphanumeric LCD.

CHAPTER-3

CIRCUIT DESCRIPTION

3. Circuit Description

3.1 Power Supply

3.1.1 Circuit Connection

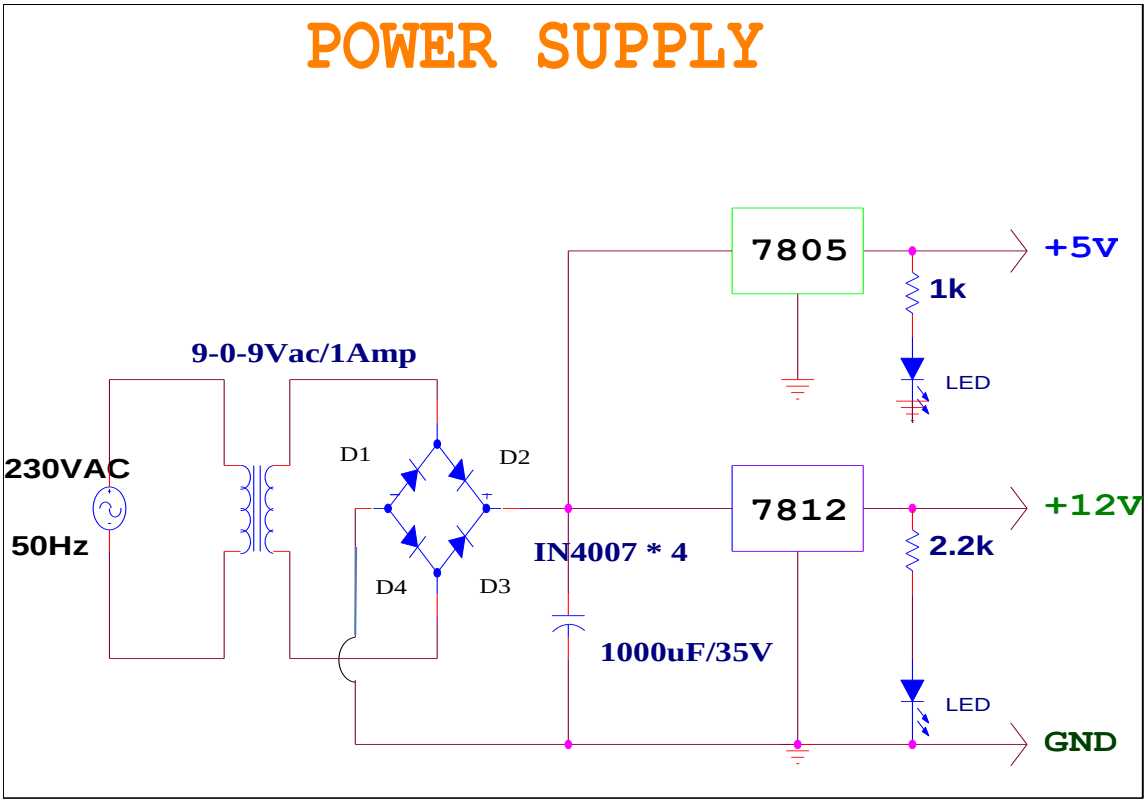
Here we are using Transformer (0-12) v, 1Amp, IC 7805 and 7812, diodes IN 4007, LED and resistors. Here 230V, 50 Hz ac signal is fed to the primary of the transformer as input and the secondary of the transformer is fed for DC output to the bridge rectifier. The IC regulator (7805 and 7812) is fed from the output of the diode for input purpose through capacitor (1000mf/35volt). The output of the IC regulator is given to the LED through resistors to detect whether the supply is ON/OFF.

3.1.2 Circuit Explanations

When we give an AC signal to the primary coil of the transformer, due to the magnetic effect of these conductors magnetic flux is induced in these conductors(primary) and this flux is transferred to the secondary conductors by the transformer action. Transformer is an electromechanical static device which transformer electrical energy from one conductors to another without any change in its frequency. Here the diodes are connected in a bridge section. The secondary conductors of the transformer is given to the bridge circuit for the purpose of rectification.

During the positive cycle of the ac signal, the diodes D2 and D4 conduct as these diodes are forward biased and diodes D1 and D3 does not conduct as these diodes are reverse biased. Similarly during the negative cycle of the ac signal, the diodes D1 and D3 conduct as these diodes are forward biased and the diodes D2 and D4 does not conduct as these diodes are reverse biased . The output of the bridge rectifier through (D2&D4) is not a pure dc and there is rippled ac present in it. A capacitor is jointed to the o/p of the diodes (D2&D3) to overcome that effect. This process removes any unwanted ac signal present in it and thus we get a pure dc signal from it. Here we need a fixed DC voltage, for that we are using IC regulators (7805 & 7812).Voltage regulation ICs are used here to supply a constant voltage regardless of changes in load current. These IC's can provide fixed voltage and with adequate heat sink. The output of the bridge rectifier is given as input to the integrated circuit regulator through a capacitor with respect to

ground and thus a fixed output is obtained. The output of the IC regulator (7805 & 7812) is given to the LED for indication purpose through resistor that power supply is ON/OFF.LED glows ON state due to the forward bias of the LED, and the o/p are obtained from the pin no-3.



3.1.2 Connection Diagram of Power Supply

3.2 Motherboard

The motherboard of this project is made with a MSC–51 core compatible microcontroller(AT89C51).With the help of printed circuit board, we have made the motherboard, compatible for the microcontroller. This board is consisting of microcontroller(AT89C51), i/p or o/p pull-up registers, oscillator section and auto reset circuit.

3.2.1 Microcontroller

The Atmel AT89 series is one of the most popular Microcontroller in use today due to their industry standard instruction set & low unit cost .The 89C51 has three very general types of memory. To effectively program the 89C51 it is necessary to have a basic understanding of these memory types. They are: On-Chip Memory, External Code Memory, and External RAM. On-chip memory refers to any memory (Code, RAM, or other) that physically exists on the Microcontroller itself[5]. AT89C51 has 4KB Flash programmable and erasable read only memory (PEROM).

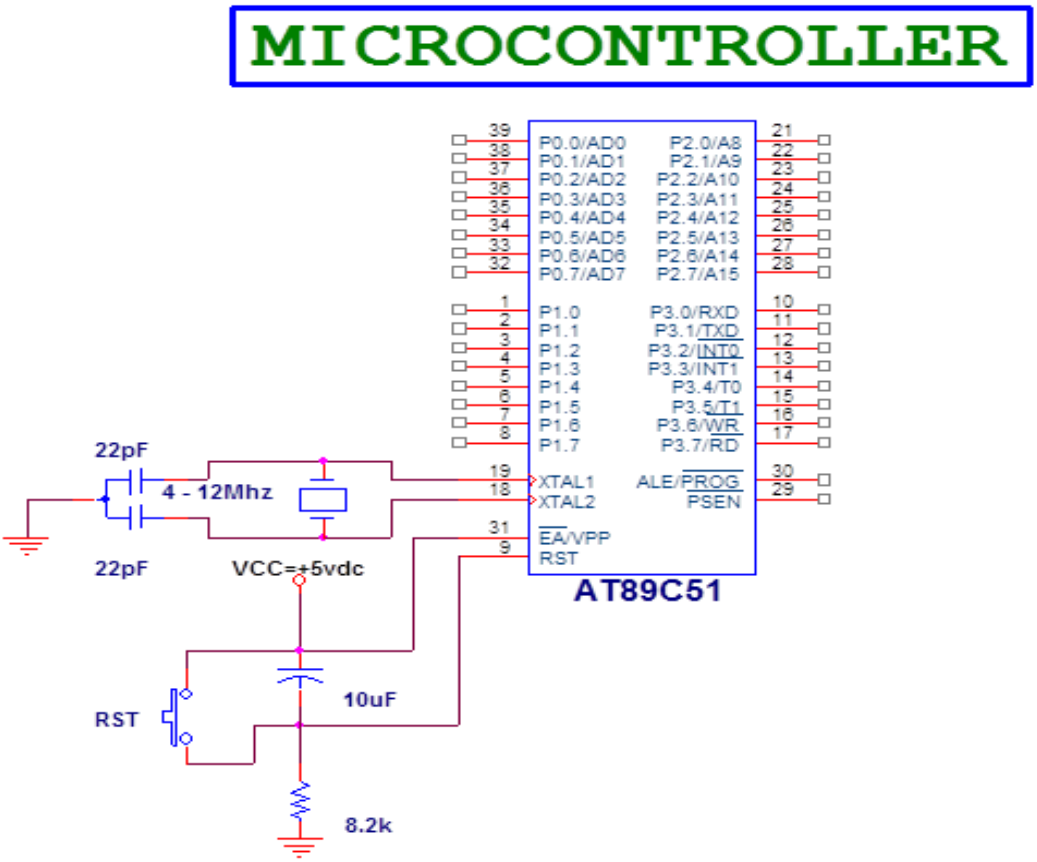
On-Chip Memory refers to any memory (Code, RAM, or other) that physically exists on the Microcontroller itself. On-chip memory can be of several types, but we'll get into that shortly. **External Code Memory** is code (or program) memory that resides off-chip. This is often in the form of an external EPROM.

External RAM is RAM memory that resides off-chip. This is often in the form of standard static RAM or flash RAM.

AT89C51 has a bank of 128 bytes of Internal RAM. This Internal RAM is found on-chip so it is the fastest RAM available, and it is also the most flexible in terms of reading, writing, and modifying it's contents. Internal RAM is volatile, so when the 89C51 is reset this memory is cleared[5].

3.2.2 Auto reset circuit

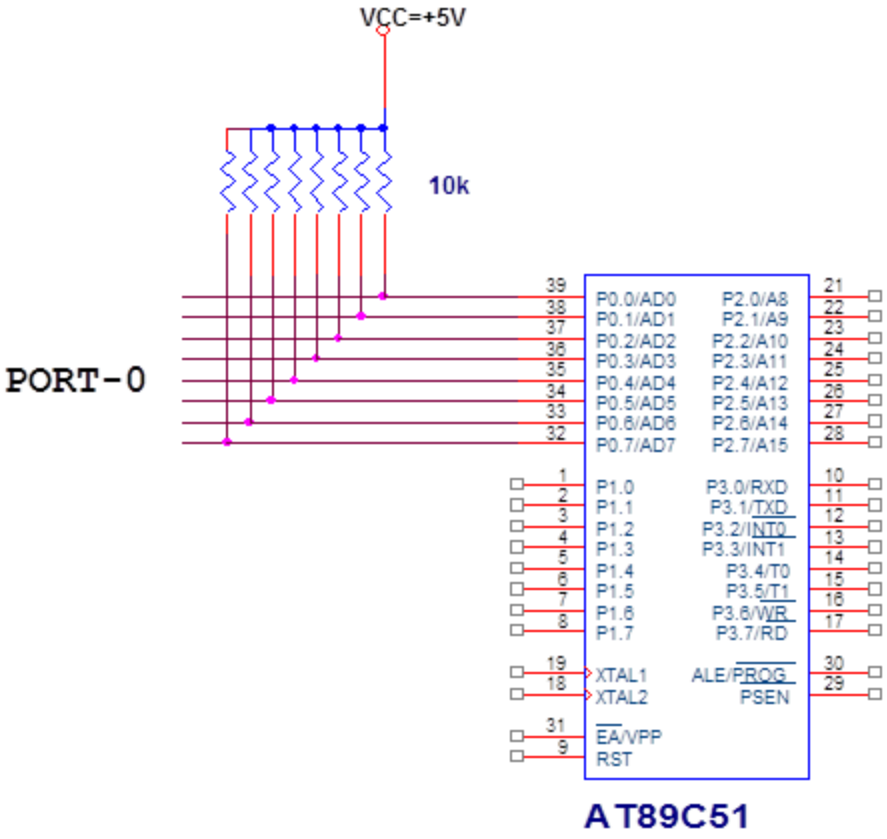
Pin -9 is the RESET pin. It is an input and is active high (normally low).Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities. This is often referred to as a power on reset. Activating a power on reset will cause all values in the register to be lost. Figure 3.2.2 shows the power on reset circuit. In order for the RESET input to be effective, it must have a minimum duration of two m/c cycle before it is allowed to go low. When power is turned ON, the circuit hold the reset pin high for an amount of time that depend upon capacitor value & the rate at which it charges. That's why a 8.2kΩ resistor & 10μf capacitor is used here[4].



3.2.2 Diagram of Oscillator section & Auto reset Circuit

3.2.3 Pull-up resisters

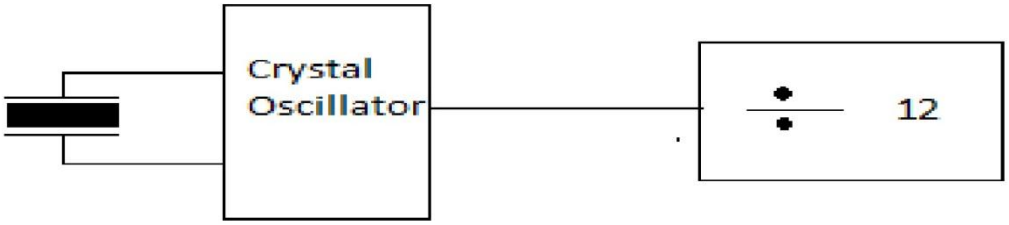
PORT 0 & PORT 2 of the AT89C51 are 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1sec are written to PORT 0and PORT 2 pins, the pins can be used as high impedance inputs[9].The pin of PORT 0 &PORT 2 is open collector type. PORT 1 &PORT 2 are provided with internal pull up resistor. Generally 10kΩ resistor is used as pull up resistor .



3.2.3 Diagram of the Input /Output Pull-UP Resisters

3.2.4 Crystal Oscillator

The AT89C51 microcontroller has on-chip crystal oscillator, but require an external crystal oscillator to run it .Most often crystal oscillator is connected to inputs XTAL1(PIN 19) and XTAL2(PIN18).This family of microcontroller can be used ranging from crystal frequency of 0 to 24MHz and there are generally two numbers of decoupling capacitors are used which is shown in the figure3.2.2. Due to piezoelectric effect these capacitor decouples the charges which developed on the crystal surface. These decoupling capacitors are of 20 to 30pf. The clock generator is designed as shown below



The Microcontroller design consist of two parts

1) Hardware
2) Software

3.2.4.1 Hardware

The Microcontroller operates on +5 V dc, so the regulated + 5v is supplied to pin 40 and ground at pin 20 by the 7805 regulator ic . 4 MHz crystal oscillator is used here for operating the processor. To reset the processor ,the pin no. 9 is supplied with a +5Volt dc through a push switch. The codes which are to be dumped to the microcontroller, are stored in the internal flash memory .

3.2.4.2 Software

For the software part we use an algorithm and is given below

a. The controller continuously scans the ports which receive inputs from maximum demand section and optical section.

b. If the optical pickup receives a pulse then the counter increments and display the unit consumed in LCD. Then count is compared to display the warning for recharging.

c. When the total unit finishes, after that the tripping relay is activated to disconnect the power.

d. If the maximum demand section gives a pulse then it activates the tripping mechanism.

e. Continuously the controller rechecks the maximum demand section and regain the power when load is reduced.

3.3 Liquid Crystal Display(LCD)

The LCD(liquid crystal display) is based upon the liquid crystal technology. By applying voltage to the LCD it becomes opaque, but before that it was a transparent material. The above property is main operating principle of LCD.

LCD is made up of two glass panel with a cavity which is present in between. The panels are sealed altogether. To form the characters for display we use an inner surface of glass which is coated with the transparent material. "Nematis" is the most common form of liquid crystal used now-a-days. The molecules which are present in this crystal are arranged in a parallel fashion which are of long rod type. By applying potential to it, the LCD changes its optical characteristics with the change in direction.

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3.3.1 Energy consumption

LCD normally requires very little amount of energy to operate, specifically ranging from 5µA to 25µA of five volts (per square inch) for the display in LCD. There is also requirement of supplementary energy for auxiliary lighting. A pure ac voltage is required for driving of LCD. Mixture of dc component with ac voltage will drastically reduce the life of the LCD. So we must limit the dc component to only 50mv.

3.3.2 Direct Drive

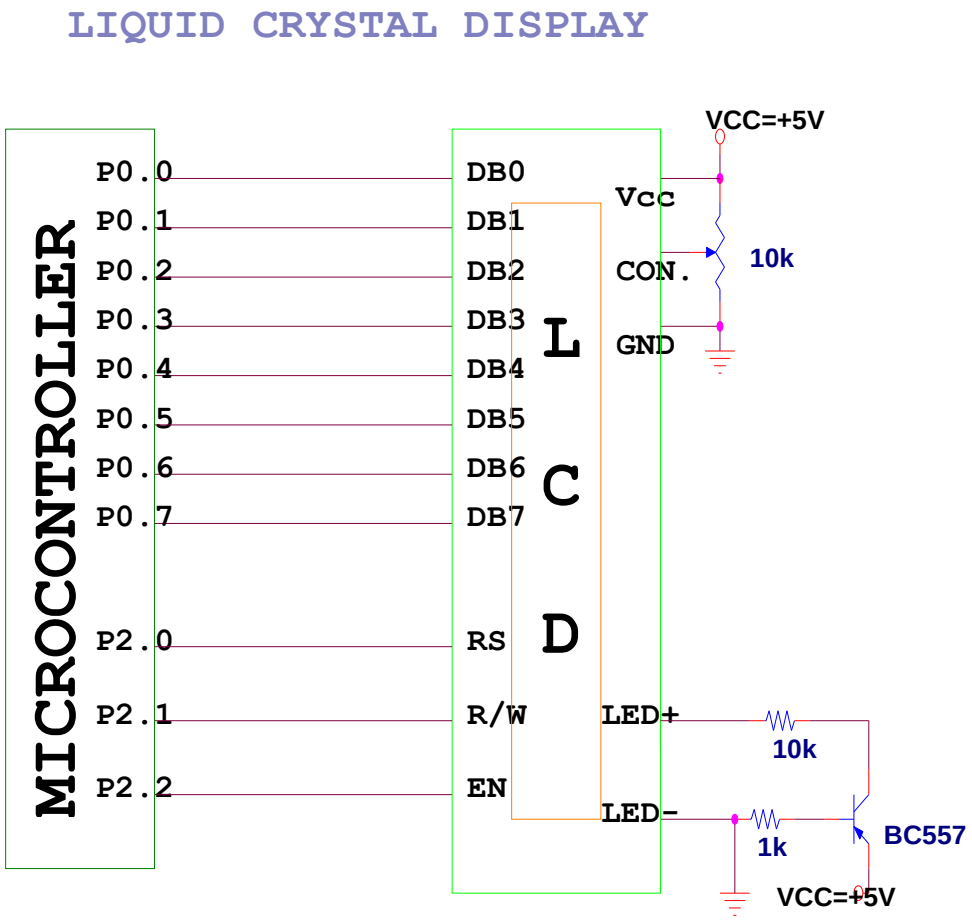
In recent years the LCD are gaining popularity over LED(seven-segment LED or other multi segment LED).This is as of following reasons

- LCDs prices are declining.
- In LCD there is the ability to display numbers, characters and graphics in contrast to LEDs.
- There is auto refresh of LCDs by the CPU to keep displaying the data as compared to LED, which must be refreshed by the CPU.
- Programming of characters and graphics are easy.

There is an independent connection present to the driver for the LCDs. The LCDs are usually find application in outdoor. Direct driver requires a frequency of 30Hz and 60Hz. There will be flicker in the display if frequency drops below 30Hz. For frequency above 60HZ,there will excessive current draw in the circuit. This is essential for battery mode operation. If voltage frequency cross the limit then LCD 'Off' segments can be adherently energized. Cross talk or ghosting is due to this partial activation of the segments .LCDs are available in different models such as one to four row may be present in the display of the LCD and also each LCD can display 8 to 20 characters. We used two rows and 16 characters LCD for our project. Almost all LCDs are of same design but the number of driver chips used are different. The LCD is powered from 5V dc supply.

We can use LCD either in 4 bit or either in 8 bit mode. The 4 bit interface saves the number of pins as compared to 8 bit interface. Thus one can save money by using a 4 bit interface. There is requirement of 3 control lines with a data line.

The above LCD is consists of 14 pins. If RS pin has zero value the instruction command code register is activated. Where as if RS pin has one value, then data register is selected. R/W pins allows user to write to the LCD or read from the LCD. E(enable) pin is used for latching the information.



3.3.3 Connection Diagram of LCD with Microcontroller

3.4 RELAY DRIVER

The relay driver is design by using a BC547 transistor .The relay used here having the specification as follows

- Coil resistance =400ohm
- Coil voltage=12Vdc
- Contact capacity=230V, 7A

The above specification indicates that the coil requires 12V dc and approx. 30mA current dc. The Microcontroller can't supply more then5-10mA(excluding pull up resistor) current. So driver section is very much required. BC548 has a typical current gain of 200 and maximum current capacity of 1A. So a typical base current of 200 μA can trigger to on the relay.

3.4.1 ELECTRO MAGNETIC RELAY

These are vary much reliable devices and widely used on field. The operating frequency of these devices are minimum 10-20ms.That is 50Hz – 100Hz.The relay which is used here can care 25mA currents continuously. The electromagnetic relay operates on the principle magnetism. When the base voltage appears at the relay driver section, the driver transistor will be driver transistor will be driven into saturation and allow to flow current in the coil of the relay, Which in turn create a magnetic field and the magnetic force produced due to that will act against the spring tension and close the contact coil. Whenever the base voltage is withdrawn the transistor goes to cutoff .So no current flow in the coil of the relay. Hence the magnetic field disappears so the contact point breaks automatically due to spring tension. Those contact points are isolated from the low voltage supply, so a high voltage switching is possible by the help of electromagnetic relays.

The electromagnetic relays normally having 2 contact points, one of this is normally closed (NC)and the other one is normally open (NO). Normally closed points will so a short CKT path when the relay is off. Normally open points will so a short circuit path when the relay is energized.

Relay section is designed to operate and drive the relays .The relays used here having following specifications.

Operating voltage = 12V DC

Coil resistance = 400Ω

Capacity of contact point = 25A, 230V

Type = single contact(NO/NC)

The relay requires 12 volts and current= 12 volt/400Ω = 33mA. The driver now require for driving this relay must be designed for translating the TTL logic value into 12 volts and 30mA

current. The Microcontroller cannot provide this much of current. In normal practice, it desirable to draw 60 to 600μA current from the Microcontroller, as the output to load current requirement is very high a transistor driver is required.

In this arrangement the base current is design for200 micro Amp.

Appling KVL,

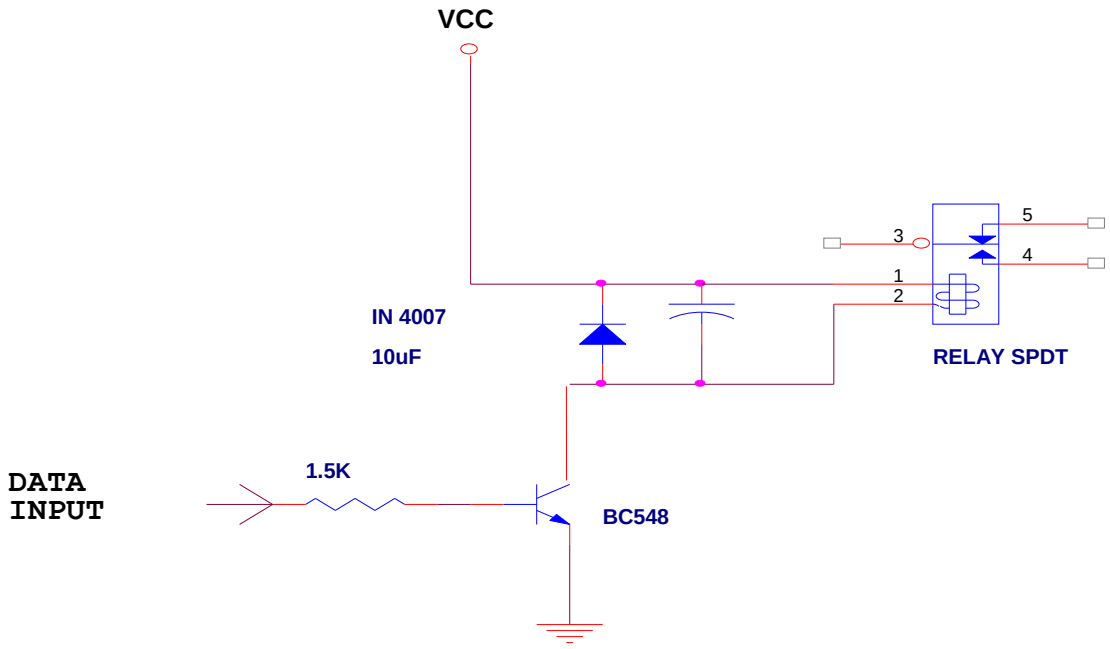
5-Rb Ib-0.7=0

Rb= 2.15k(max)

Rb= 2.15k(min)

Whenever the relay driver section receives a signal from the controller, the driver transistor driven into saturation, on removal of signal the driver transistor will be driven into cut-off.

RELAY DRIVER



3.4 Connection diagram of Relay driver

3.5 OVER CURRENT DETECTOR

This is a circuit designed to detect over current. In this section a special type of CT is used to detect very low current. The output of this CT is proportional to the Load current and the output of this CT is also ac one. The CT voltage varies with load current.

The line voltage (230vac) coming from the mains is given to the one end of primary of the current transformer and another end through a load (15W) to the neutral. The current in the primary conductor of the CT induce an voltage in the secondary of the CT. In this special type of CT the primary COIL IS ONE TURN AND SECONDARY IS 200TURN. If the load varies, the CT output also varies in according with the load current. The output voltage of the CT depends on the primary flux density. The CT is designed with 10 SWG wire at primary side and 40 SWG wire at the secondary side. The principle of operation of this CT as simple as the normal single winding CT coil, but the construction is a cell type to measure low current. As the low load current cannot produce high flux density a multiple turns of primary is made increase the flux density.

In the over current detector circuit the conversion of ac voltage to dc voltage is done by the half-wave rectifier. In this circuit the importance of designing the rectifier is at the priority to achieve the accuracy and precession.

The sample voltage can be calibrated by varying the load resistance RL. The main part of designing the circuit is to sample the load current and produce a dc voltage as an replica to the ac load current. The Current Transformer (CT) samples the load current as a reduced signal voltage

$Vac = (N2/N1)*fm *K$

where Vac is ac voltage

N2 is number of turns in the secondary

N1 is number of turns in the primary

fm is frequency of the system

K is some constant

The output voltage waveform of the CT is quit poor, so a careful design of rectifier circuit is desired. While choosing the time constant of the circuit following precautions are required to be followed,

The DC voltage after the half wave rectifier is approximately Vm due to the charging of the capacitor. The line voltage is represented by this capacitor. $C*R_L$ represents the time constant of the circuit. The time constant of the circuit must be more than five times of the time period of the signal, which means RC is greater than 5T or RC>5T. If the RC < 5T, then unnecessarily the sample voltage fluctuates. The sampling response becomes too slow if there is too high value of RC.

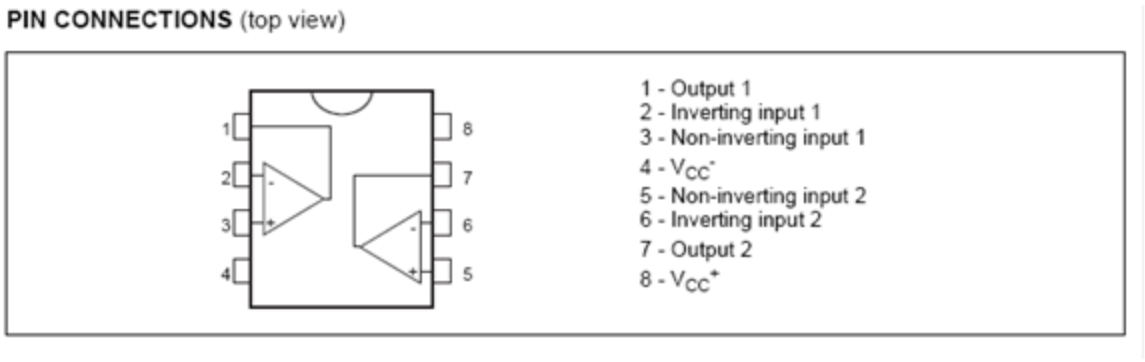
3.5.1 Operation

The output of the sampling voltage (3v) given to the input of the comparator. We set a voltage of say 3.5 in the comparator to the inverting end. The non-inverting terminal is less than inverting terminal in this case. The line voltage is in the normal condition due to low output of the comparator. If the current increases, the corresponding voltage will increase. That voltage is given to the input of the non-inverting terminal(which is a reference voltage) of the OP-amp (lm393) what we use as a voltage comparator.

In this comparator we have to set the voltage say 3.5V to the inverting terminal. In this case inverting terminal is lesser than the non-inverting terminal. Which means output of the comparator becomes +Vsat which is HIGH this means that over current has occurred. The o/p of the comparator is connected to a led indicator circuit to indicate the high low condition.

3.5.2 DESCRIPTION (LM393)

There is two independent low voltage comparators in the device which are designed to operate from an one supply over a much range of voltages. It can also work from split power supplies. These comparators have the unique characteristic that the input common-mode voltage range includes ground even in the case when it is operated from a single power supply voltage.



3.5.2 Pin Connection diagram of LM393(Overcurrent Detector)[11]

3.5.3 Features

1- WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES :(+2V TO +36V OR ±1V TO ±18V)

2- VERY LOW SUPPLY CURRENT (0.4MA) INDEPENDENT OF SUPPLY VOLTAGE (1MW/COMPARATOR AT +5V)

3- LOW INPUT BIAS CURRENT : 25NA TYP

4- LOW INPUT OFFSET CURRENT : ±5NA TYP

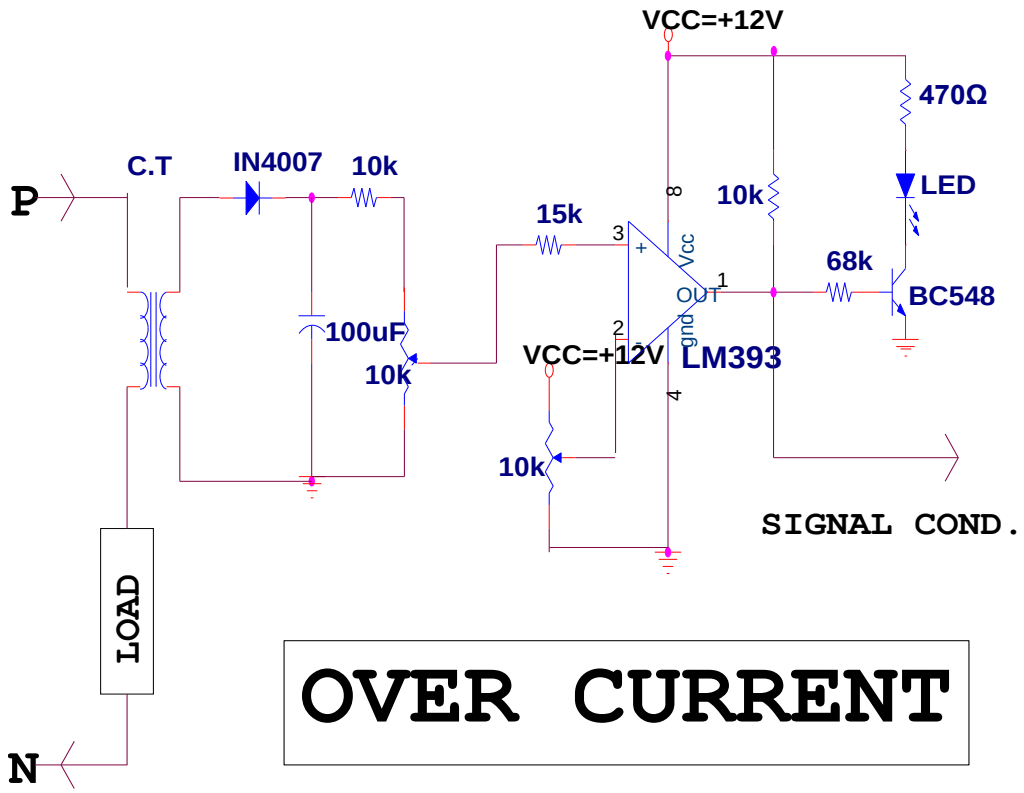
5- LOW INPUT OFFSET VOLTAGE : ±1MV TYP

6- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND

7- LOW OUTPUT SATURATION VOLTAGE : 250MV TYP. (IO = 4MA)

8- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE SUPPLY VOLTAGE

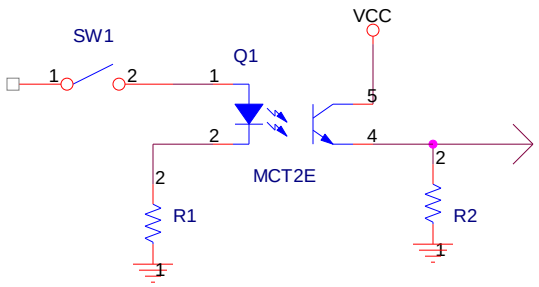
9- TTL, DTL, ECL, MOS, CMOS COMPATIBLE OUTPUTS



3.5 Connection diagram of Over Current Detector

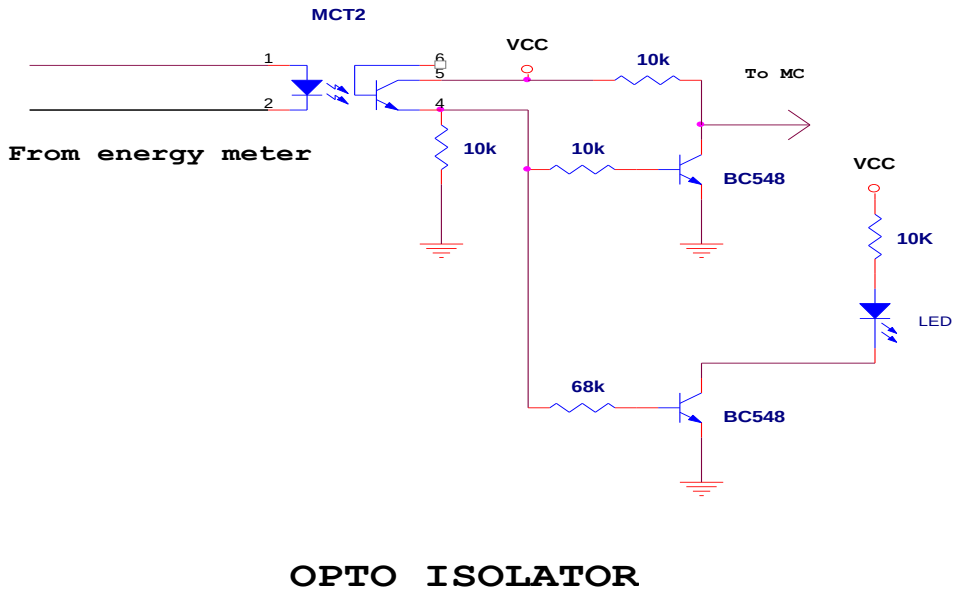
3.6 Opto-isolator

An optocoupler/opto-isolator is a device containing an infrared LED and a matching phototransistor, mounted close together (optically coupled) within a light-excluding package as shown in below figure.



3.6 (a) Pin connection diagram of Optocoupler

Here the switch sw1 is normally open, so current through the LED will be zero. So Q1 remains in dark and zero current passes through it, so zero voltage appears across R2. When the switch sw1 is closed, current flows through the LED via R1, thus illuminating Q1 and causing it to generate an output voltage across R2. The R2 output voltage can thus be controlled via the R1 input current, even though R1 and R2 are fully isolated electrically. In practice, the device optocoupler can use either digital or analogue signals. It can provide very high volts of insulation between two circuits.



3.6 (b) Pin connection diagram of Opto-isolator

3.7 DTMF ENCODER & DECODER

3.7.1 DTMF

When we dial on the keypad on the phone there is production of tone and these tone can represent the digits and a we can represent each digit for an each tone. There is random sound on a same frequency and if we use a single frequency for a system, then it can lead to trip of the system. If we use two tone to represent a digit, then occurring of false signal can be eradicated. This is the basis of Dual Tone Multi Frequency (DTMF).When we press a key on the phone,

there is generation of two tones of specific frequency. One tone is generated from high frequency and low frequency.

DTMF represents Dual Tone Multi Frequency. On DTMF signals baseband multiplexing is absent. The signal produced from a DTMF encoder is the direct algebraic summation of the amplitudes of the two cosine(sine) waves of different frequencies, i.e. pressing '0' will send a tone made by adding 1336 Hz and 941 Hz to the other end of the line.

The touch tone system uses two number of tones to shows the different keys. There is a "low tone" and a "high tone" connected with each button (0 through 9, plus * (star) and # (octothorpe or pound symbol). The tones are represented as follows:

(HIGH TONES)

1209	1336	1477	1633 Hz	
1	2	3	A	697 Hz
4	5	6	B	770 Hz
7	8	9	C	852 Hz
*	0	#	D	941 Hz

(LOW TONES)

3.7.1 Matrix form of a DTMF

or:

```
1 is summation of 697+1209
2 is summation of 697+1336
3 is summation of 697+1477
4 is summation of 770+1209
5 is summation of 770+1336
6 is summation of 770+1477
7 is summation of 852+1209
```

```
8 is summation of 852+1336
9 is summation of 852+1477
0 is summation of 941+1336
* is summation of 941+1209
# is summation of 941+1477
A is summation of 697+1633
B is summation of 770+1633
C is summation of 852+1633
D is summation of 941+1633
```

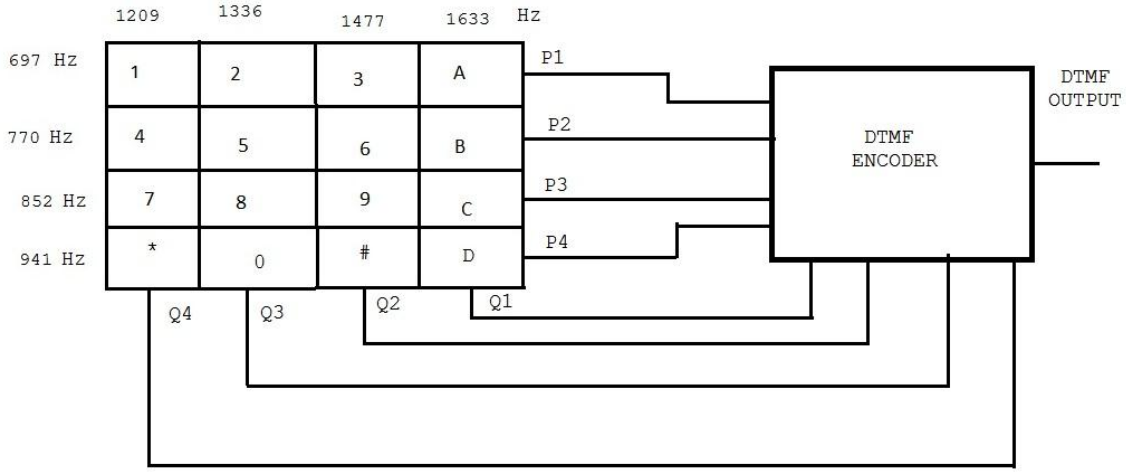
When we press the button, the 770 Hz and 1209 Hz tones are sent together from the DTMF encoder. The DTMF decoder decodes the tone and generates the equivalent of the key number at the output.

To avoid other problems and harmonics, we use tone frequencies that may be produced when two tones are sent and received. Accurate transmission from the encoder and accurate decoding on the decoder is important. When we dial the numbers, they sound musical (and representations of many popular tunes are possible).

The tones that are used should all be +/- 1.5% of nominal. The high frequency tone should be at least loud and it would be good if it is louder than the low frequency. This would be as much as 4 db louder. This factor we call it "twist." If a Touchtone signal has +3db of twist, then it represents that the low frequency is 3 db slower than the high frequency. Negative twist happens when the low frequency is louder than high frequency.

3.7.1.1 Encoding DTMF

There are many ways to generate DTMF tone. Using oscillator and filter array is one of the method also this can be designed by using lookup table in the digital method. The Integrated IC version is having one key board section, on receiving proper row column section the tone generator section generator generates DTMF tone output.



3.7.1.1 Connection diagram of a DTMF Encoder

3.7.1.2 Encoder IC Operation

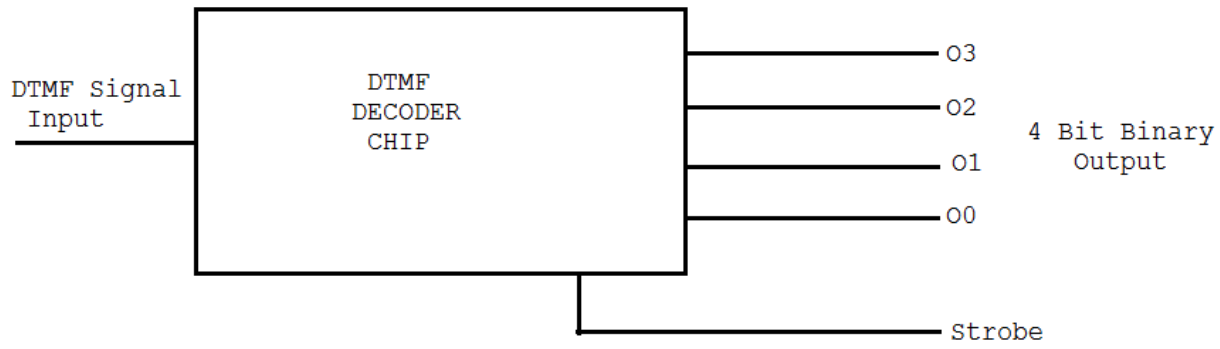
The DTMF encoder IC UM91214B/ UM91215B based circuit generates DTMF frequencies as per the key pressed in the keyboard connected to the ROW and COULMN of the IC. For its operation the above IC require 3 volts. A zener diode voltage regulator provides this 3 volts, which gives 3 volts from 9 volts for the use of the above IC. The IC for its time base requires a 3.58 MHz of quartz crystal. The Encoder IC Pins 1 and 2 are used as DTMF mode select and chip select pins respectively. When the row pin 12 and column pin 15 are shorted to each other, there is a output from its pin 7 corresponding to digit 1 of DTMF tones.

3.7.2 DTMF DECODER

3.7.2.1 Decoding DTMF

There are so many other ways present to decode and detect these DTMF tones. One idea could be combination of both eight sharp-tuned filter and detection circuits. This could be very

impractical, considering the various ICs (Integrated Circuits or 'chips') made by so many different other manufacturers. Many of these ICs require crystal oscillator or resonator upto 3.58 MHz and not more than that and power circuitry. The output has is 4-bit binary with 1 strobe.

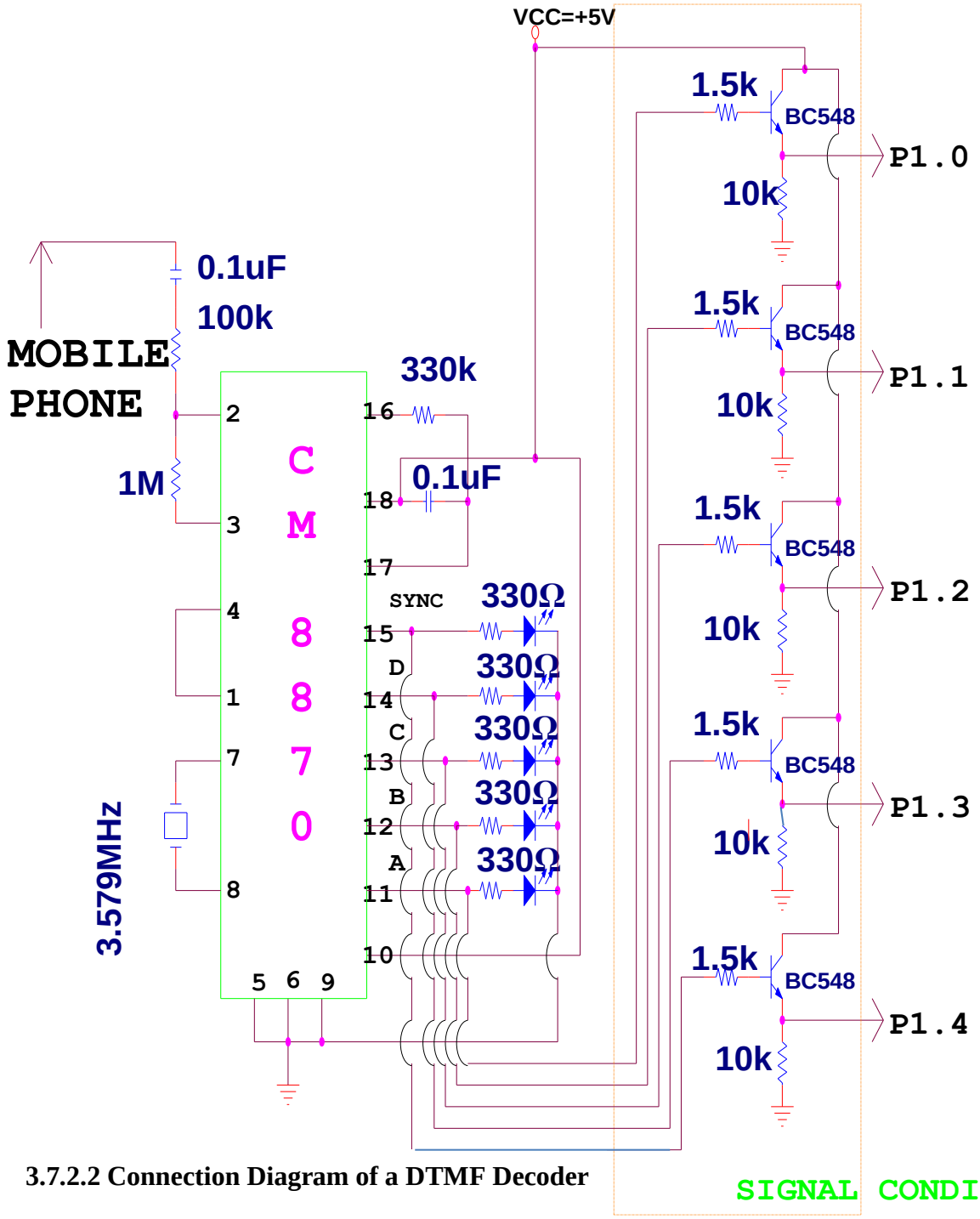


3.7.2.1 Pin Configuration of DTMF Decoder

3.7.2.2 Decoder IC Operation

The frequency modulated Dual Tone Multi Frequency signals are taken by the FM(Frequency Modulator) receiver and the output (DTMF tones) are given to the dedicated IC KT3170 works as a DTMF-to-BCD converter. This IC gives the corresponding BCD output when we give DTMF tone. For example, when digit 2 is pressed, the output is 0010 and when digit 3 is pressed the output is 0011. There is a requirement of 3058Mz crystal for the operation of IC KT3170.

DTMF DECODER(CM8870)



3.7.2.2 Connection Diagram of a DTMF Decoder

3.8 MUSIC GENERATOR

The melody generator circuit has two section one is melody generation section and other one is a power amplifier. The UM66 integrated circuit and transistor together generate the melody and the IC LM380 and its allied component is designed to act as an power amplifier. The output of the amplifier, for generation of audible music, is feed to the speaker.

3.8.1 DESCRIPTION OF UM66xx IC

For use in door bell, toy application and telephone we use the IC of UM66TXXL series which are CMOS LSI designed. It is used for musical performance and it has on-chip ROM which can be programmed. The device consume very low power as it is produced by CMOS technology. Since the UM66TXXL series include oscillation circuits a compact melody module can be made from few additional components

3.8.2 FEATURES

*It has Rom memory of 64-Note
*It requires power supply of 1.5V~4,5V and it consumes low power
* With an external NPN transistor a dynamic speaker can be driven
*OSC resistors of hold mode
*There is presence of power on reset
*Built in level hold mode

3.8.3 FUNCTIONAL DESCRIPTION

OSCILLATOR CIRCUIT

For beat and tone generators, the oscillator frequency is used as a reciprocal of frequency. The quality of the music can be hampered by its accuracy.

TONE GENERATOR

Tone Frequencies generated from tone generator are oscillator frequencies-m, where m represents any even number from 64 to 256. Pause code and End code can be included for

selecting 14C scales within a melody. The tone generator acts as a programmed divider. The range of frequency is from 258Hz to 23768Hz and range of scales varies from C4 to C6.

RHYTHM GENERATOR

The rhythm generator is also acts as a programmed dividers. One can select four rhythms from them.

MELODY ROM

The Mask Rom can remember 64 notes with 6 bit.For controlling the scale code we use 4 bits and we use 2 bits for controlling the rhythm code

TEMPO GENERATOR

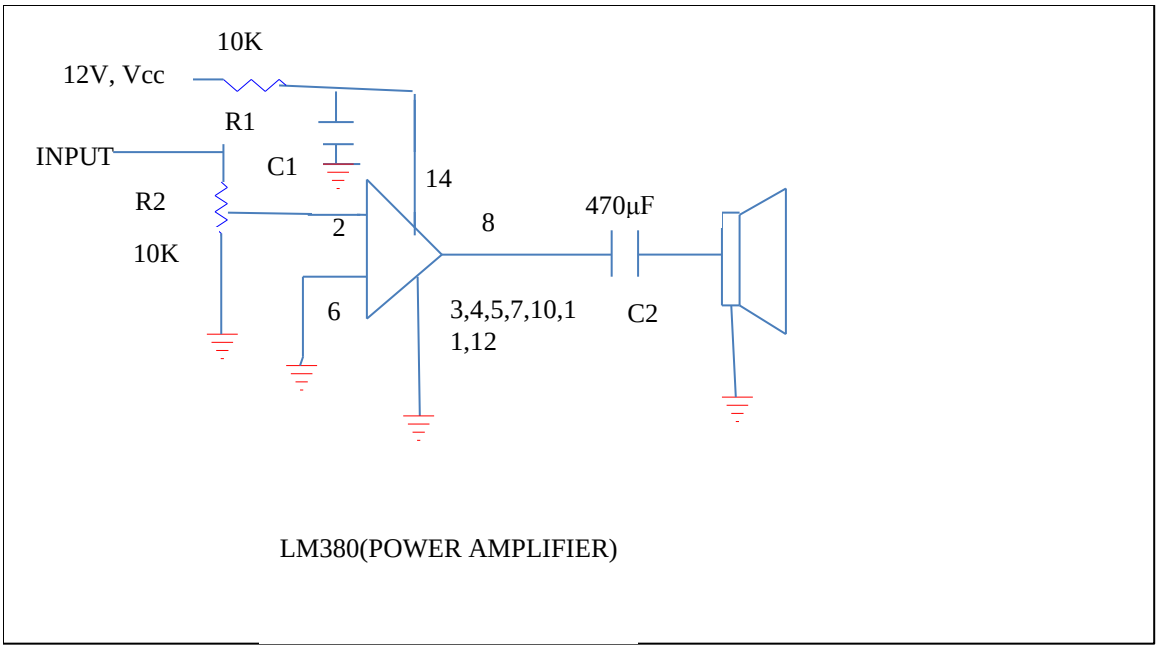
In IC UM66T series 15 tempos are available.

3.8.4CIRCUIT DESCRIPTION:

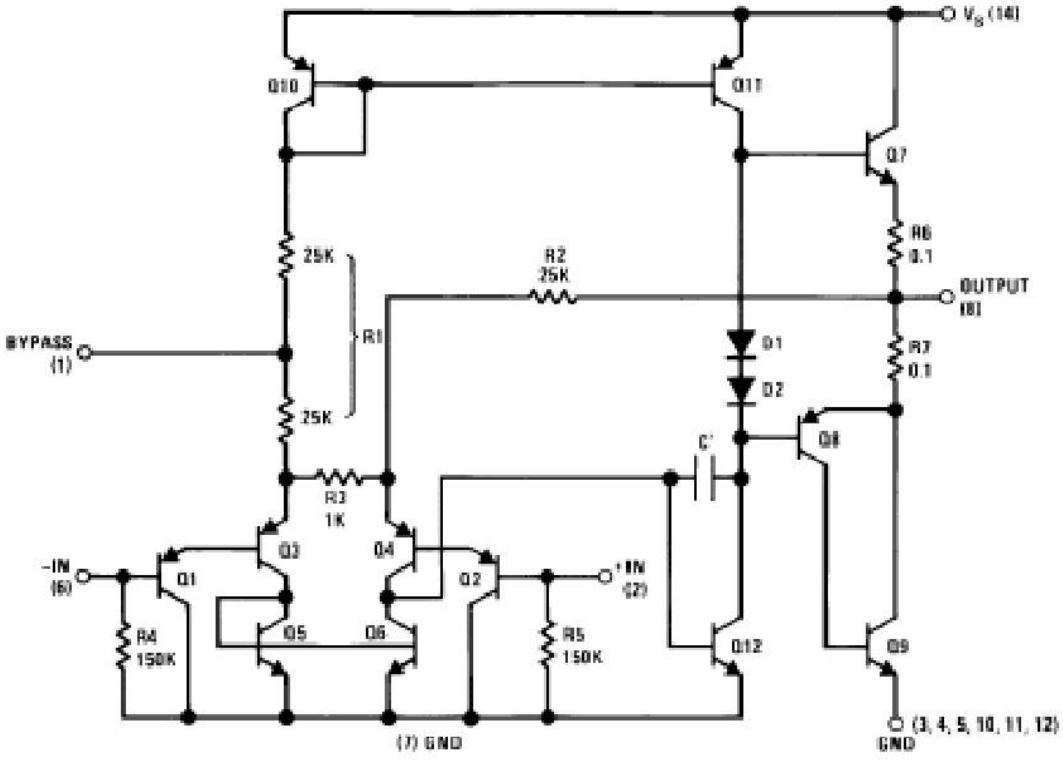
The zener diode is provided to regulate and provide an 3.1volt to the chip and the capacitor in parallel to it used for ripple and transient filter. Already the melody is stored in the ROM of UM66 IC when the transistor receive a active high signal at its base then it drive into saturation region and a 3.1 volt appears at the Vdd pin (2) of UM66 IC and the IC start generating melody at output pin(3). The same signal is very week to drive a 4Ω speaker so an audio amplifier is cascaded at the output of IC UM66.

3.8.5 DESCRIPTION OF LM380 IC

The IC LM380 is a self contained audio power amplifier almost all the components are integrated except a coupling capacitor. The LM380 is used for consumer applications as a power audio amplifier. An internally constant gain of 50 (34 dB), shows by it and the output automatically centers itself to the one-half of the supply voltage. The inputs are ground referenced or ac coupled which is allowed by a unique input stage. By use of both thermal shutdown and short circuit current limiting circuitry, we can protect the output stage of LM380.There is minimum external parts counted for integrated circuit for audio applications due to vast internally provided features .The circuit operation of the LM380,methods of tone control and volume control distortion and a high input impedance audio amplifier and its power handling capability are described by this paper.



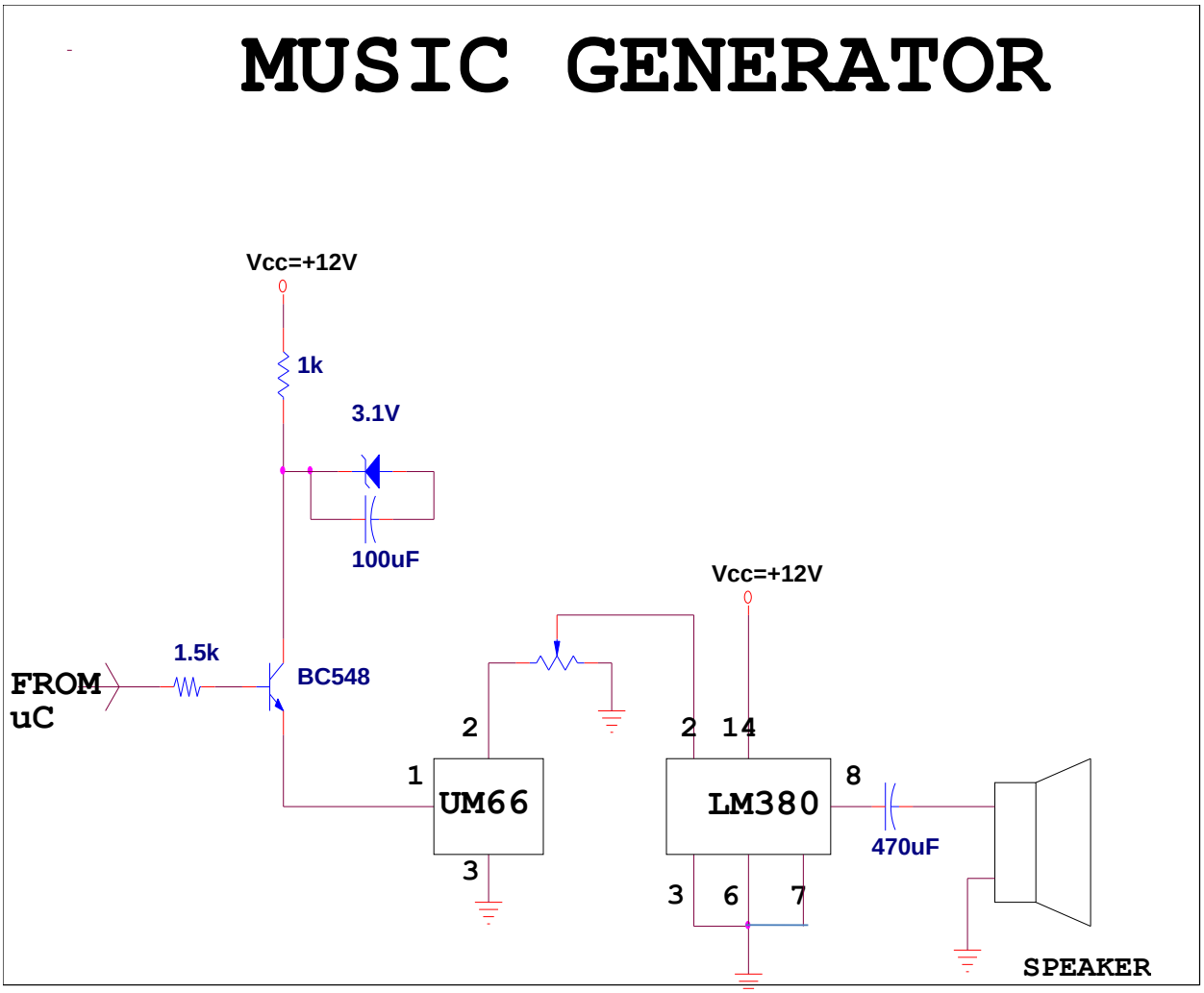
3.8.5 Connection diagram of a LM380(power amplifier)



3.8.5.1 Schematic diagram of a LM380(internal structure)[12]

3.8.5.1 CIRCUIT DESCRIPTION (INTERNAL STRUCTURE)

Figure 3.8.5.1 shows a simplified circuit schematic diagram of the LM380. The input stage is a slave current-source load with PNP differential pair. The input transducer can be directly coupled by choosing the PNP input as reference for input to ground. By the help of resistor ratio R1/R2,the output can be biased to half the supply voltage. As R1 = 2 R2 (From Figure 3.8.5.1) negative dc feedback can balances the differential stage with the output at half way through resistor R2.The second stage works as a current-source load and also as a common emitter voltage gain amplifier. By the help of the pole-splitting capacitor C, internal compensation can be provided. The result wide power bandwidth (100 kHz at 2W, 8X) can be preserved by pole-splitting compensation. A constant gain of 34 dB or 50 dB is produced for the amplifier. By the internal feedback network R2-R3,we can get this much of gain. Due to the slave current source the gain is double of the ratio R2/R3 and slave current source gives the full differential gain of the input stage.

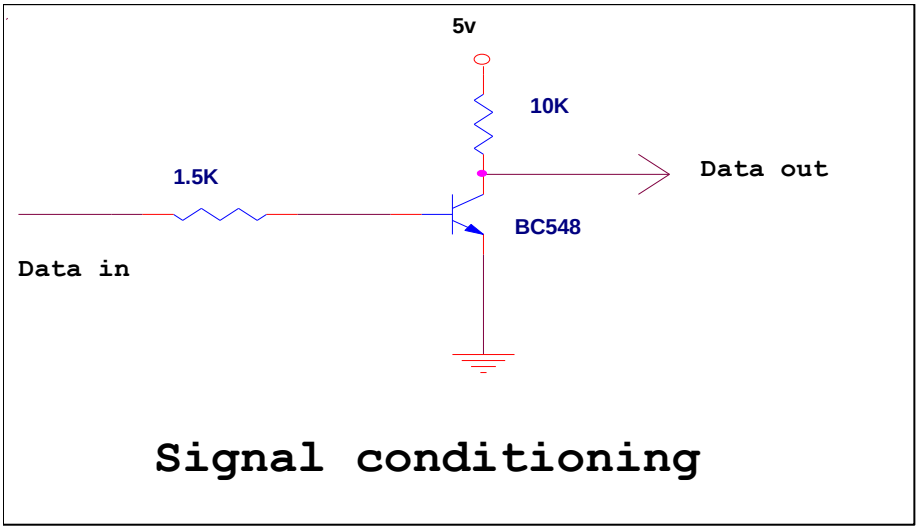


3.8 Connection diagram of a Music Generator

3.9 SIGNAL CONDITIONING

The output form the input signal i.e. from decoder or any other circuit must be compatible with the μ -controller, because an input voltage of 5V is taken by the μ -controller and an output

voltage of 5V is given by it. That for we need a amplifier/signal conditioning circuit as given in the below figure.



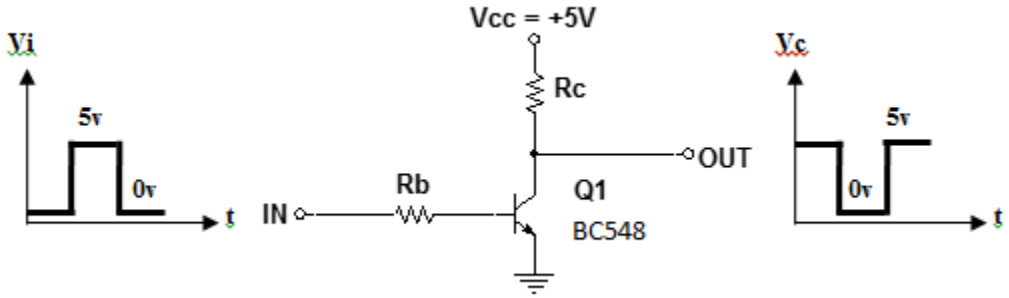
3.9 Circuit Diagram of a Signal conditioning

The transistor becomes saturate if the base voltage is high that is the output becomes a low voltage corresponding to the ground as there is a flow of current from emitter to collector section. Through a current limiting resistance the output from the signal conditioning is taken from the collector junction and the output signal is given to the μ - controller or any other different circuit that needs is compatible with (5V/0V) voltage. There is a flow current from the collector junction when the base voltage becomes, so the output becomes high voltage similar to Vcc. Through a current limiting resistance the output from the signal conditioning is taken from the emitter junction and the output signal is given to the μ - controller or any other different circuit that needs is compatible with (5V/0V) voltage.

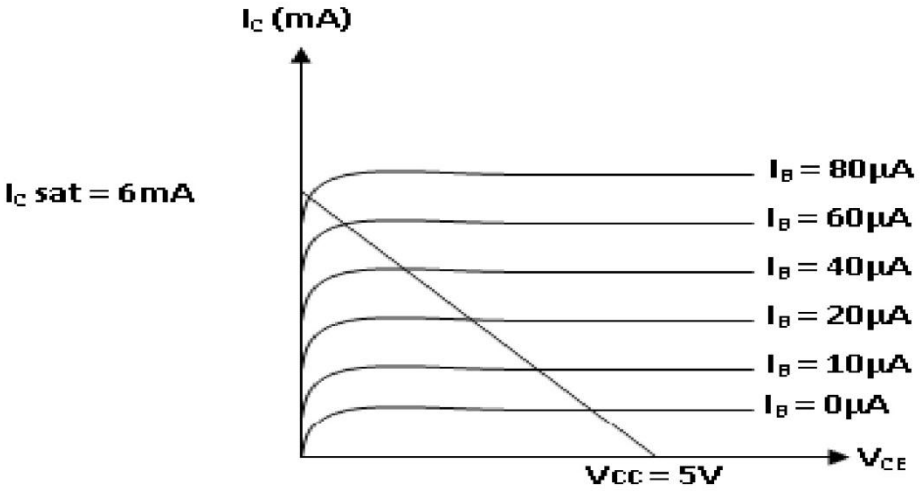
3.9.1 Circuit description

The use of the transistors are not limited only for amplification purpose. By the efficient design of the transistors, these can find application in some control application and also these can be worked as switches for computers.

The network of figure 3.9.1(a),can be used as in computer logic circuitry for the application purpose of an inverter. Here the output voltage of Vcc is in opposition to the applied voltage of the input or the base terminal. Here there is no connection of dc supply to the base circuit. There is a dc source connected to the output side or to the collector. For computer applications the magnitude of the applied signal is of 5V.



3.9.1(a) Diagram of Transistor act as Inverter



3.9.1(b) Load line characteristics

3.9.2 OPERATION

From the above figure 3.9.1(b), it is clear that the operating point shifts from cut-off region along the load line to the saturation region for making a better inversion process. For our proposes we will assume that I_C(the collector current)= I_{CEO} = 0mA, when I_B(the base current) = 0µA (an

excellent approximation in light of improving construction techniques), as presented in the above given figure 3.9.1 (b). We will also assume that V_{CE} collector to emitter) = V_{CE} saturation = 0V.

When Vi(input voltage) = 5v, the on(working) state will be the present new status of the transistor and In case I_B curve is approaching near to saturation level, it must be ensured that the network is heavily saturated by some level of I_B higher than the associated level for the designing of the circuit. In this above given figure 3.9.1 (b), this requires that $I_B > 50\mu A$.

The saturation level for Ic(the collector current) of the given circuit is defined by,

$$I_C = V_{CC} - VCE / R_C$$

$$= 5V - 0.2V / 10K$$

$$= 480\mu A$$

Just before the saturation the amount of base current(I_B) in the active region can be approximated by the following equation,

$$I_B\ min \approx I_C\ sat / \beta dc$$

$$= 480\mu A / 300$$

$$= 1.6\mu A$$

We must therefore ensure for the saturation level that the given following condition is satisfied:

$$I_B\ maximum > I_C\ saturation / \beta dc$$

For the network of the above figure 3.9.1 (b),when Vi = 5v the resulting level of(base current) I_B is

Assume

$$I_B = 100\mu A$$

$$5v - R_B I_B - 0.7v = 0$$

$$R_B\ (max) = 4.3 / 100\mu A = 43k\Omega$$

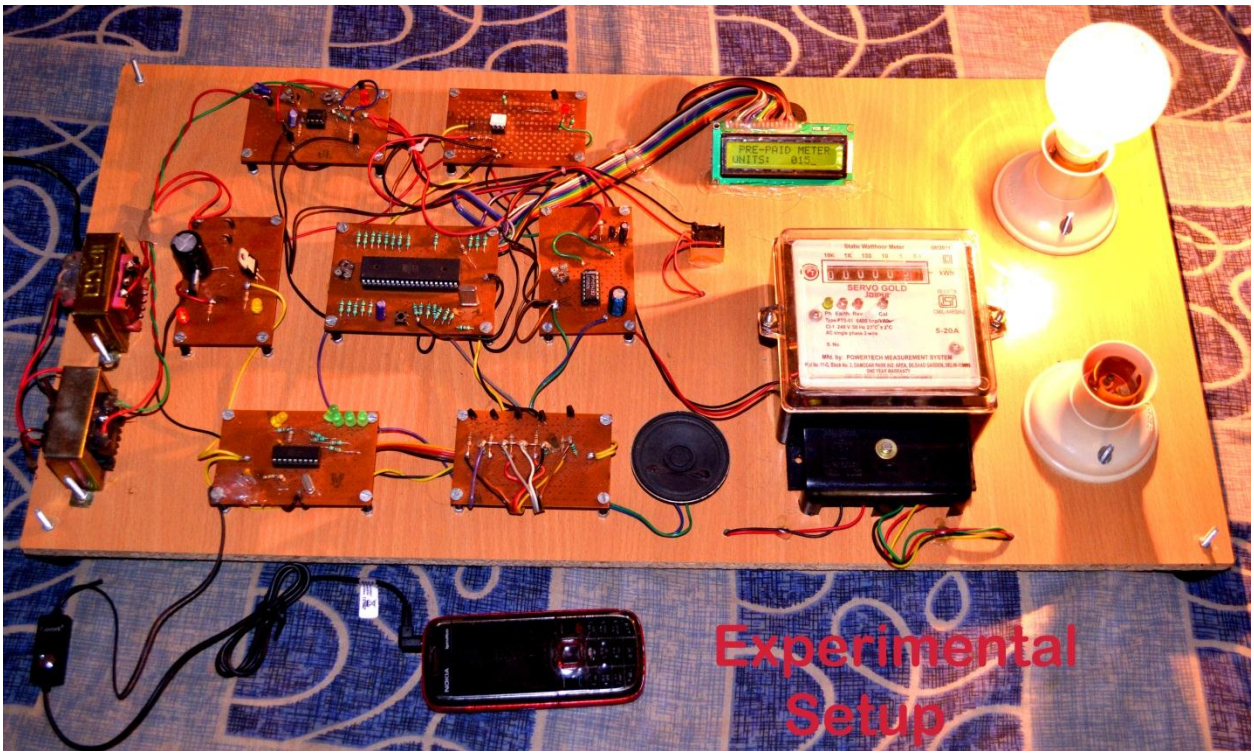
$$R_B\ (min) = 4.3 / I_B(max) = 1k\Omega$$

Which is satisfied. Certainly any level of I_B greater than 16µA will pass through the bias Q-point on the load line which is very near to the vertical axis.

CHAPTER-4

Experimental Setup

4.1 Setup:



4.1 Figure of Experimental Setup

CHAPTER-5

BENEFITS OF REMOTE ELECTRICITY BILLING SYSTEM

5.1 Benefits Of Remote Electricity Billing System

- Prepaid energy meter is used to improve the operational efficiency as there is no need of men for meter reading .The disconnection & reconnection is automatic. It can help to control appropriation of electricity in a better way than traditional metering .
- As the payment is online/by recharge voucher , it improve the cash flows and also improved revenue management system, which will reduces the financial risk.
- Customer service is also improved by using this. By the use of prepaid energy meter the billing delay and extra cost due to disconnection/reconnection can be removed and we can use the electrical energy in a controlled manner which helps the consumer to save their money through better energy management.

5.2 Market Drivers

- Due to increase in the need of electrical power ,the consumer focused on the deregulated power distribution market which is forcing the market participants to make the existing metering and billing process in a competent way. This drive the prepaid market.
- Metering errors, tampering with meters is belongs to non-technical losses which leads to low registration and calibration related frauds. In India it is greater than 10 percent. By using prepaid meters we can control non-technical losses in a better way than conventional ones.
- Most of the Asian countries do not have 100% electrification; hence by the increasing generating capacity new markets are being created . The Prepaid energy meter unit can be more easily introduced in such type of new markets rather than the existing ones for enhance the electrification.

CHAPTER-6

FUTURE EXPANSION

6.1 Future Expansion

This project is designed with constraint of time and cost. This can be developed with following facility,

- This project can be modified to send the information regarding the balance charge operating condition etc.
- The system can be interfaced with the sensors to check different types of meter tampering and fault conditions.
- This controller can have one embedded power factor controller to correct the power factor.
- In this project the data communication is through a mobile network which is little bit expensive media but it can be modified to communicate through Ethernet communication using TCP/IP protocols.
- In this project a electromagnetic meter is being used for reading the energy consumption. We can replace the electromagnetic meter by an electronic meter unit.

CHAPTER-7

CONCLUSION

7.1 Conclusion

This project present a model for prepaid meter using mobile communication. It is demonstrated for measuring the electrical energy consumption of an electrical load for single phase system. This microcontroller based energy meter prototype which is implemented to provide upto 0.4 amp load from a 230 volt to neutral voltage. In the overloaded condition it will draws more than 0.4 amp current then the bulb will fluctuate (ON/OFF) rapidly. By removing the extra load we can stop the overloaded condition .In real life it will remove the problem of load shadding. The process of reading of energy meter is done by LCD which is more simpler than that for analog meter .If the consumer will not pay the bill then there is no need of man to go & cut the power supply, here the model has the advantage that if consumer will not pay the money then after consuming the rest unit it will automatically disconnect the load from power supply. This energy meter has the potential to change the traditional billing system. The energy billing system may help the energy distribution companies to reduce costs and increase profits, to improve metering and billing accuracy and efficiency, and to contribute the energy in a sustainable way.

The test results obtained by the model is quite satisfactory and found to be having very much less error then the experimental tolerance level. This has been observed that the system is quite stable and do not show any error or instability during its operation.

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